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AN ANNOTATED BIBLIOGRAPHY OF THE LARCH CASEBEARER (*Coleophora laricella* [Hübner])

Compiled by
Robert E. Denton and
Leon J. Theroux

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RANGE EXPERIMENT STATION
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THE AUTHORS

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INTERMOUNTAIN FOREST AND RANGE EXPERIMENT STATION
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Ogden, Utah 84401

PREFACE

This bibliography is complete through 1977. Because many of the articles are in foreign languages and we were unable to have all of them translated, we relied on abstracting journals, such as the Review of Applied Entomology, to provide some of the annotations.

The results of initial surveys and studies of the larch casebearer in the western United States were commonly issued as unpublished reports. These reports are listed in the appendix.

RESEARCH SUMMARY

The contents of 147 published references on the larch casebearer are annotated. Citations are cross-referenced by subject as well as by author. An appendix lists 30 unpublished reports.

BIBLIOGRAPHY

1. AMMAN, GENE D., and SCOTT TUNNOCK. 1971. Radiographic detection of *Agathis pumila*, a parasite of the larch casebearer. J. Econ. Entomol. 64(5):1086-1088.

Casebearer larvae, while still in their cases, were radiographed on Kodak type M film using an X-ray exposure of 5 kV and 3 mA for 4 minutes. Immature parasite larvae could not be detected consistently because their density was similar to that of the host, hence they lacked contrast. However, mature parasite larvae were detected with 100 percent accuracy. Contents of all cases were identified with up to 97 percent accuracy. Radiography may be useful where a quick check is needed to determine if the parasite is established.

2. ANDREWS, R. J. 1966. First record of the larch casebearer on western larch in British Columbia. Can. Dep. For., Bi-mon. Res. Notes 22(6):3.

Larch casebearer was first collected in British Columbia in 1966. The largest populations, averaging 4 larvae per 12-inch branch, were in the Creston area.

3. ANDREWS, R. J., and N. J. GEISTLINGER. 1969. Parasites of the larch casebearer, *Coleophora laricella* (Hbn.), in British Columbia (Lepidoptera: Coleophoridae). J. Entomol. Soc. B.C. 66:50-51.

Nine species of parasites were recovered from rearings of the casebearer in British Columbia, 1966-1968: *Bracon* sp., *Scambus decorus*, *Scambus transgressus*, *Gelis tenellus*, *Dicladocerus westwoodii*, *Tetrastichus xanthops*, *Amblymerus* sp., *Sceptrothelys deione*, and *Spilochalcis albifrons*. In 1968, parasitism averaged 4 percent, with the highest percentage (14 percent) occurring near Creston.

4. BAIRD, A. B. 1923. Some notes on the natural control of the larch sawfly and larch case bearer in New Brunswick in 1922. Acadian Entomol. Soc. Proc., N.S. (1922) 8:158-171.

Predation by five species of birds is credited with causing 25 percent mortality of casebearers in the spring. Four species of parasites were recovered, with a maximum of 8.5 percent parasitism. Nonhatch of eggs accounted for 25 percent mortality.

5. BAKER, WHITEFORD L. 1972. Eastern forest insects. U.S. Dep. Agric. Misc. Publ. 1175, 642 p.

Includes a brief description of life stages and life history of the larch casebearer in eastern United States.

6. BODEN, FRANZ. 1902. Die Lärche und die Motte. (The larch and the moth.) Z. f. Forst- u. Jagdwes. 34:21-24.

Describes the feeding behavior of the casebearer on several larch species in Germany.

7. BOUSFIELD, W. E., and R. C. LOOD. 1973. Parasites of the larch casebearer in Montana, Idaho, and Washington. Environ. Entomol. 2(2):212-213.

Twenty parasitic species were reared from the casebearer from 95 locations in Montana, Idaho, and Washington. *Spilochalcis albifrons* and *Dicladocerus* sp. were the most abundant native species recovered. *Agathis pumila*, an introduced parasite, was recovered from 58 percent of the release sites sampled.

8. BRITTON, W. E. 1924. The larch leaf-miner or case-bearer. *Coleophora laricella* Hubn. *In* 23rd Rep. State Entomol. Conn., 1923, p. 288-291. Conn. Agric. Exp. Stn. Bull. 256.

Describes the larch casebearer's injury to larch, its life history, and its life stages, with mention of natural enemies and control measures.

9. BRITTON, W. E. 1933. Larch case bearer, *Coleophora laricella*. *In* Plant Pest Handbook, p. 122. Conn. Agric. Exp. Stn. Bull. 344.

Briefly recounts the life history of larch casebearer in Connecticut.

10. BROWN, MARK WENDELL. 1977. A partial life table for the larch casebearer *Coleophora laricella* (LEPIDOPTERA: COLEOPHORIDAE), with notes on egg dispersion. M.S. (For.) Thesis, Univ. Idaho, Moscow, 32 p.

More than twice as many eggs were found on branches exposed to insolation as on shaded branches. A Chi-square test, the coefficient of dispersion, and Morisita's Index all showed a high degree of egg aggregation. The dispersion pattern of the eggs fitted the negative binomial distribution. Aggregation was attributed primarily to environmental conditions. Mortality during the time from oviposition to the overwintering stage was 67.68 percent. Most of the mortality was caused by density-independent factors, particularly the needle cast fungus *Meria laricis*. Egg predation and the number of nonviable eggs were significantly greater on branches exposed to insolation.

11. BURST, ROLF, and GUSTAV EWALD. 1955. Neue Untersuchungen über die Biologie und die Bekämpfungsmöglichkeiten der Lärchenminiermotte. (New investigations on the bionomics and possibilities of control of the larch casebearer.) Allg. Forstz. 10:326-329.

In an insecticide test against overwintered larvae, a spray containing 0.909 percent DNC (dinitro-orthocresol) applied on March 16 before bud burst gave 99.6 percent kill, compared with 29 percent mortality on unsprayed trees. In similar tests against active larvae, a 0.2 percent BHC (benzene hexachloride) emulsion applied on March 31 gave 89 percent kill, compared with 9 percent for no treatment. A spray of 0.2 percent BHC or 0.3 percent malathion gave good control of the casebearer adult when applied on June 8. A spray of 1 percent DNC was applied on October 12 to induce premature defoliation of trees while the larvae were still feeding. The needles fell within 2 weeks and examination showed that there were no larvae left on the trees.

12. CIESLA, W. M., and W. E. BOUSFIELD. 1974. Forecasting potential defoliation by larch casebearer in the northern Rocky Mountains. J. Econ. Entomol. 67(1): 47-51.

A quadratic regression model ($Y = 4.015 + 0.4419X - 0.001036X^2$) for forecasting defoliation potential by larch casebearer on western larch was developed. The model utilizes systematic counts (X) of overwintering casebearer larvae on 40 branch samples per sample point to forecast the intensity of feeding injury, which is expressed as a numerical rating (Y) and can be translated into four broad classes of damage: negligible, light, moderate, and heavy. The model predicts potential feeding injury to within one defoliation class, 98 out of 100 times.

13. CODY, JACK B. 1963. The rate of spread of *Agathis pumila* (Ratz.) and its interaction with *Epilampsis laricinellae* (Ratz.). M.For. Thesis, Univ. Mich., Ann Arbor, 31 p.

Larch casebearer collections in 1954 and 1963 suggest *A. pumila* is able to spread at a rate of more than 30 miles (48 km) per year. It spread from Elmwood, Michigan, to Fosston, Minnesota, a distance of 335 miles (571 km) in 10 years. It is suggested that when both *Agathis* and *Epilampsis* are present and the casebearer population is high, the latter is the most numerous parasite. Conversely, when casebearer populations are low, *Agathis* is more numerous and *Epilampsis* is virtually absent.

14. CODY, JACK B., FRED B. KNIGHT, and SAMUEL A. GRAHAM. 1967. The hymenopterous parasites *Agathis pumila* (Braconidae) and *Epilampsis laricinellae* (Eulophidae) on the larch casebearer (Lepidoptera: Coleophoridae) in the northern Lake States. Mich. Entomol. 1(5):159-167.

Gives the history of larch casebearer and its two most important parasites in Michigan, Wisconsin, and Minnesota. Interactions of the parasites are discussed. It appears that *A. pumila* is an effective parasite by itself, but *E. laricinellae* depends upon the presence of *A. pumila* to increase its numbers to effective levels. It is suggested that alternating high populations of *A. pumila* and *E. laricinellae* result from the interactions between these two parasites.

15. COPPEL, HARRY C., and ROY D. SHENEFELT. 1960. Parasites introduced to help control the European larch casebearer--a progress report. Univ. Wisc. For. Res. Notes 53, 3 p.

Few insect parasites of larch casebearer were present in Wisconsin before the introduction of *Agathis pumila* and *Chrysocharis laricinellae*. Within 5 years both species became established, but *A. pumila* had a wider distribution and in some counties it appears to be the only beneficial parasite operative.

16. COPPEL, HARRY C., and NORMAN F. SLOAN. 1971. Avian predation, an important adjunct in suppression of larch casebearer and introduced pine sawfly populations in Wisconsin forests. Tall Timber Conf. Ecol., Anim. Contr. Habitat Manage. Proc. 2D:259-272.

Selected studies on the impact of bird predation on forest insects in different geographical regions are reviewed. Results obtained in Wisconsin in studies to determine the effects of bird predation on the larch casebearer are outlined.

17. DAVIAULT, LIONEL. 1949. Notes sur la biologie et les parasites du porte-case du mélèze (*Coleophora laricella* Hbn.) dans la province de Québec. (Notes on the biology and the parasites of the larch casebearer in the province of Quebec.) Ann. de l'ACFAS 15:90-92.

Gives the life history and biology of the casebearer in Quebec. Ten parasite species were recovered; however, the amount of parasitism did not exceed 20 percent.

18. DAWSON, A. F. 1971. Larch casebearer in British Columbia. Can. For. Serv., Pac. For. Res. Cent. Pest Leafl. 34, 3 p. Victoria, B.C.

Recounts the appearance of larch casebearer in British Columbia, including its description, its life history, the appearance of damage, and natural controls.

19. DENTON, ROBERT E. 1958. The larch casebearer in Idaho--a new defoliator record for western forests. USDA For. Serv., Intermt. For. and Range Exp. Stn. Res. Note 51, 6 p. Ogden, Utah.

Reports the discovery of larch casebearer in western larch forests around St. Maries, Idaho, in 1957.

20. DENTON, ROBERT E. 1965. Larch casebearer in western larch forests. USDA For. Serv., For. Pest Leafl. 96, 6 p. Washington, D.C.

Summarizes the casebearer's geographic range in the West, and describes life stages, life history, damage caused, and control. (Superseded by Denton and Tunnock 1972.)

21. DENTON, ROBERT E. 1967. Low-volume application of malathion for controlling larch casebearer. Mont. Acad. Sci. Proc. 1966:26-58.

Summarizes the results of aerial spray tests against the casebearer. Technical grade malathion, at a dosage of 8 fl oz per acre (584.8 cc/ha), gave 95.6 percent control of the casebearer.

22. DENTON, ROBERT E. 1967. Biological control of the larch casebearer. 18th West. For. Insect Work Conf. Proc. 1967:67-68.

Reports the initial success of establishing *Agathis pumila* for biocontrol of the casebearer in western larch forests.

23. DENTON, ROBERT E. 1972. Establishment of *Agathis pumila* (Ratz.) for control of larch casebearer, and notes on native parasitism and predation in Idaho. USDA For. Serv. Res. Note INT-164, 6 p. Intermt. For. and Range Exp. Stn., Ogden, Utah.

Describes results achieved 10 years after an attempt to biologically control the casebearer by releasing 2,360 *A. pumila* at five locations near St. Maries, Idaho. Information is provided on the role of native parasites and predators as biocontrol agents.

24. DENTON, ROBERT E., and SCOTT TUNNOCK. 1968. Low-volume application of malathion by helicopter for controlling larch casebearer. J. Econ. Entomol. 61(2): 582-583.

Low-volume application of 8 fl oz technical grade malathion per acre (584.8 cc/ha) resulted in 95.6 percent control of larch casebearer.

25. DENTON, ROBERT E., and SCOTT TUNNOCK. 1972. Larch casebearer in western larch forests. USDA For. Serv., For. Pest Leafl. 96 (rev.), 8 p. Washington, D.C.

Summarizes the casebearer's geographic range in the West, its life history, damage it causes, its life stages, and natural and applied control measures.

26. DOWDEN, PHILIP B. 1934. Recently introduced parasites of three important forest insects. Ann. Entomol. Soc. Am. 27:601-602.

Reports the introduction of parasites of three forest insects. *Chrysocharis laricinellae*, *Angitia laricinella*, and *Bassus pumilus* from Austria were introduced for control of larch casebearer in the New England States.

27. DOWDEN, PHILIP B. 1962. Parasites and predators of forest insects liberated in the United States through 1960. USDA For. Serv., Agric. Handb. 226, 70 p. Washington, D.C.

Lists five species of parasites introduced from Europe for biocontrol of larch casebearer in the United States. The location, year, and number of insects released are given.

28. DOWDEN, P. B., and P. A. BERRY. 1938. European parasites of *Rhyacionia buoliana* (Schiff.), *Coleophora laricella* Hbn. and *Phyllotoma nemorata* (Fall.). J. Econ. Entomol. 31:459-460.

Two of five hymenopterous parasites released in the East to control the casebearer were recovered (*Bassus pumilus* and *Chrysocharis laricinellae*).

29. EIDMANN, H. H. 1958. Lärkträdsmalen (*Coleophora laricella* Hbn.). (Larch casebearer.) *In* Sven. Skogsvardfören. Tidskr., p. 399-418.

Describes the larch casebearer's occurrence, life history, habits, and damage it caused in Sweden.

30. EIDMANN, H. 1959. Om diapausen hos *Coleophora laricella* Hbn. (On the diapause of the larch casebearer.) Not. Entomol. 39:80-81.

Diapause of the larch casebearer is closely associated with the rest period of *Larix* species. In November, 50 percent of the larch buds kept at 71.6°F (22°C) burst after 22 days and the casebearer broke hibernation after 23 days. In January, it was 9 to 10 days for both, and in March about 4 days for both. Thus, diapause of the casebearer represents a physiological mechanism that helps the larvae survive the winter months and begin feeding when their food is again available.

31. EIDMANN, HUBERTUS. 1961. Zur Entwicklung von *Epilampsis boops* Thoms. und *Cirrospilus pictus* Nees, zwei Parasiten der Lärchenminiermotte *Coleophora laricella* Hbn. (The development of *Epilampsis boops* Thoms. and *Cirrospilus pictus* Nees, two parasites of the larch casebearer.) Entomol. Tidskr. 82:52-59.

E. boops and *C. pictus* are the most common hymenopterous parasites of *Coleophora laricella* in Sweden. The life history of *C. laricella* is described and laboratory observations on the development of the parasites in the overwintering larvae are recorded.

32. EIDMANN, H. 1962. Untersuchungen über die Entwicklung von Parasiten bei *Coleophora laricella* Hbn. mit Hilfe von Röntgenphotographie. (Investigations on the development of parasites of the larch casebearer with the help of X-ray photography.) Z. f. Angew. Entomol. 50:118-125.

Investigations were carried out in 1960-61 to determine the best time in the spring to apply chemical treatments against the casebearer without injuring the eulophid parasites *Epilampsis boops* and *Cirrospilus pictus*. Overwintering larvae were collected starting in mid-January and reared through the spring. Development of the parasites was followed by means of X-rays. It was concluded that chemical treatment should be applied at or just before the casebearer resumes spring feeding, when the parasites are still in the immature stages in the host.

33. EIDMANN, HUBERTUS H. 1965. Ökologische und physiologische Studien über die Lärchenminiermotte, *Coleophora laricella* Hbn. (Ecological and physiological studies of the larch casebearer.) Stud. For. Suec. 32, 226 p.

A comprehensive review of research in Sweden, covering the casebearer's distribution, morphology, life cycle and development, damage caused, control, effect of the environment (climatic factors, disease, parasites, predators, etc.) on fertility and mortality, fluctuations in populations, and diapause.

34. ELLIOTT, K. R., and V. HILDAHL. 1966. First record of the larch casebearer in Manitoba. Can. Dep. For., Bi-mon. Res. Notes 22(4):3-4.

Reports the discovery of larch casebearer in the southeastern corner of Manitoba, Canada, in 1965.

35. ESCERHICH, K. 1931. Die Forstinsekten Mitteleuropas. (The forest insects of central Europe). 825 p. Verlag. Paul Parey, Berlin.

Includes a section on larch casebearer, giving its description, life history, distribution, damage caused, and types of natural control--mainly weather, birds, and parasites.

36. EWALD, GUSTAV, and ROLF BURST. 1959. Untersuchungen über Lärchenblasenfuss und Lärchenminiermotte. (Some investigations on the larch thrips and the larch casebearer.) Allg. Forst- u. Jagdz. 130:173-181.

The spread of the larch thrips, *Taeniothrips laricivorum*, on the forest district of Neckargemünd, Germany, from 1954 to 1956 is described. Damage to larch is not simply correlated to the population density of *Taeniothrips*, but also depends on the weather that conditions the larch. Damage caused by the casebearer is described for the same period, and figures are given for population densities and winter mortality. A comparison of the growth in height of 45 infested trees and 45 trees that were kept free of the casebearer by spraying showed statistically significant differences. The susceptibility of larch and some protective measures are discussed.

37. FAL'KOVICH, M. I. 1964. Chekhlonoski (Lepidoptera: Coleophoridae) povrezhdayushchie listvennitsu V S.S.S.R., ikh rasprostranenie i istoricheskie svyazi s kormovymi rasteniyami. (Casebearers damaging the larch in the U.S.S.R., their distribution and historical relations to host plants.) Zool. Zh. 43(6):851-858.

In the Soviet Union, larch is defoliated by three species of *Coleophora: C. laricella*, which infests *Larix decidua* in western and eastern Europe (including the Carpathian region), and two new species, described from adults of both sexes as *C. sibirica* and *C. dahurica*. *C. sibirica* mostly infests *L. sibirica* and occurs in European Russia and in Siberia (as far as the Baikal area). *C. dahurica* feeds on *L. dahurica* in eastern Siberia and the Soviet Far East. The divergence of these species from an original casebearer species appears to have resulted from the isolation of different larch species in the Tertiary period.

38. FELT, EPHRAIM PORTER. 1905. Insects affecting park and woodland trees. N.Y. State Mus. Mem. 8:170-171.

Reports the presence of larch casebearer in New York, its description, life history, and distribution.

39. FERNALD, H. T. 1919. Notes on the larch case bearer (*Coleophora laricella* Hbn.). Can. Entomol. 51(11):264.

Acknowledges the presence of larch casebearer in Northampton, Massachusetts, in 1919 with brief descriptions of the egg and first instar larva.

40. FLETCHER, JAMES. 1906. Insects injurious to Ontario crops in 1905. Entomol. Soc. Ont. Annu. Rep. 36:90.

Reports the presence of larch casebearer on European larch at the Experimental Farm in Ottawa, Canada. Brief accounts are given of the insect's life history and habits.

41. FRANSEN, J. J. 1948. Bestrijding van de Larkismot (*Coleophora laricella*). (Control of the larch casebearer.) Ned. Boschb.-Tijdschr. 20:41-56.

Of several chemicals tested, only DNC (dinitro-orthocresol) was effective when applied against overwintering casebearer larvae.

42. FREEMAN, T. N. 1967. Annotated keys to some nearctic leaf-mining Lepidoptera on conifers. Can. Entomol. 99(4):419-435.

Six annotated keys describe the larval behavior of 28 species of Lepidoptera (including larch casebearer) that mine the leaves of *Picea* sp., *Abies* sp., *Tsuga canadensis*, *Larix* sp., *Juniperus* sp., and *Thuja occidentalis*.

43. FULMEK, L. 1917. Die Lärchenminiermotte. (The larch casebearer.) Natur. Leipzig 20:212-214.

Larch casebearer is one of the most serious pests affecting larch in Austria and Germany. Its life history is described.

44. GAUSS, RUDOLF. 1957. Die Lärchenminiermotte, *Coleophora laricella* Hb., ein neuer Schädling an der Douglasie? (The larch casebearer, a new pest of Douglas-fir?) Z. f. Angew. Entomol. 40:52-54.

In 1956, *C. laricella* was found infesting young Douglas-fir in Germany. Similar infestations had previously been reported in Austria and Holland. Foliage examination revealed high larval mortality, which was attributed to the unsuitability of Douglas-fir needles as a food source.

45. GAUSS, RUDOLF. 1960. Über Nahrungspflanzen-Wechsel bei Insekten. (On changes of food-plants by insects.) Z. f. Angew. Entomol. 45(3):313-316.

Reports larch casebearer feeding on Douglas-fir in northern Baden, Germany, in 1956.

46. GRAHAM, A. R. 1944. The establishment of some imported parasites of the larch casebearer, *Haplotilia laricella* Hbn., in Ontario. Entomol. Soc. Ont. Annu. Rep., 1943, 74:48-52.

Describes the casebearer's life history and reproductive potential, native parasitism, parasite introduction, recovery of imported parasites, and parasitic recolonization in Eastern Canada.

47. GRAHAM, A. R. 1949. Developments in the control of the larch casebearer, *Coleophora laricella* (Hbn.). Entomol. Soc. Ont. Annu. Rep., 1948, 79:45-50.

Reports the recolonization of *Chrysocharis laricinellae* and *Agathis pumila* in Eastern Canada and Newfoundland from 1942 to 1947. The biology, interrelationships, and rate of dispersal are given for both parasites.

48. GRAHAM, A. R. 1958. Effectiveness of two introduced parasites of the larch casebearer, *Coleophora laricella* (Hbn.) (Lepidoptera: Coleophoridae), in Ontario. Entomol. Soc. Ont. Annu. Rep., 1957, 88:37-41.

Casebearer larvae were obtained in April-May 1957, from larch in 56 localities in an area of 65,000 mi^2 (168,350 km^2) in southern Ontario. Dissection of these larvae showed that *Agathis pumila*, which had been liberated at four points in the area from 1935 to 1941, had become established throughout the region even though infestation by Coleophora was light and the larch stands discontinuous. The parasite may have reached the extreme northwest of the survey area from a release in Michigan in 1956 rather than

from the releases made in Ontario. Parasitism varied from 41 percent south of latitude 43°N and 15 percent north of 46° to 67 percent between 44° and 45°. The average mortality of the casebearer from all other factors during the winter ranged from 2 percent south of 43° to 32 percent north of 46°. *A. pumila* is the most effective agent controlling *Coleophora* in Ontario south of Lake Superior. *Chrysocharis laricinellae*, introduced at the same time, was also recovered, but it needs a high host population for effective reproduction and had only spread a maximum of 42 miles (68 km) since 1934. There were indications that birds destroyed up to 21 percent of the overwintering larvae along their migration routes.

49. HAGEN, H. A. 1886. *Coleophora laricella* Hb, very injurious to *Larix europea* in Massachusetts. Can. Entomol. 18:125-126.

Reports the discovery of larch casebearer on *Larix europea* at Northampton, Massachusetts, in 1886.

50. HANSEN, JAMES D. 1977. The biology and behavior of *Spilochalcis albifrons* (Hymenoptera: Chalcididae), a parasite of the larch casebearer, *Coleophora laricella* (Lepidoptera: Coleophoridae). Ph.D. Thesis, Wash. State Univ., Pullman, 124 p.

Reports the biology, distribution, morphology, artificial propagation and development, and behavioral observations of *S. albifrons*, a native parasite of the larch casebearer. The interactions among the casebearer, *S. albifrons*, and other parasites of the casebearer are discussed. The use of radiography demonstrated that parasitized casebearers could be easily distinguished from nonparasitized individuals.

51. HERRICK, GLENN W. 1911. Notes on the life-history of the larch casebearer (*Coleophora laricella.*). Ann. Entomol. Soc. Am. 4:68-70.

Reports on the life history and habits of the casebearer based on field and laboratory observations.

52. HERRICK, GLENN W. 1912. The larch case-bearer. Cornell Univ. Agric. Exp. Stn. Bull. 322, p. 37-54.

The first detailed report, based on observations made at Cornell University, of the larch casebearer's distribution, life history, habits, parasites, and control on ornamental larch trees in North America.

53. HERRICK, GLENN W. 1935. The larch case-bearer *Coleophora laricella* Hbn. *In* Insect enemies of shade trees, p. 138-140. Comstock Publ. Co., Ithaca, N.Y.

Briefly recounts the casebearer's description, life history, control, and injuries to eastern and European larch.

54. JAGSCH, ALBERT. 1973. Populationsdynamik und Parasitenkomplex der Lärchminiermotte, *Coleophora laricella* Hbn., im natürlichen Verbreitungsgebiet der Europäischen Lärche, *Larix decidua* Mill. (Population dynamics and parasite complex of the larch casebearer in the natural area of distribution of European larch.) Z. f. Angew. Entomol. 73(1):1-42.

The most important factors regulating density of *Coleophora* were the following: birds (in winter), intraspecific competition of young larvae mining in needles, insufficient synchronization between larvae and development of buds in spring, and unfavorable climatic factors. Parasitic Hymenoptera were unimportant.

55. JAHN, E., and A. SINREICH. 1960. Auftreten von Forstschädlingen in Österreich 1950-1959. (Beginning of forest damage studies in Austria 1950-1959). Anz. f. Schädlingskde 33:117-125.

Lists the outbreaks of 35 important forest insect pests, including larch casebearer, in Austria from 1950-1959.

56. JUNG, WILHELM. 1942. Beiträge zur Kenntnis der Lärchenminiermotte (*Coleophora laricella* Hbn.). (Contributions to the knowledge of the larch casebearer.) Z. f. Angew. Entomol. 29:475-517.

Detailed observations were made of *C. laricella* on *Larix kaempferi* and *L. decidua* during the course of an outbreak in Baden, Germany. The life history of the casebearer is given, and immature stages, larval excreta, and cases are described. Infestation for several years results in loss of tree growth and weakened trees that become more susceptible to diseases. In extreme cases, trees are killed by continuous infestation. Severest attacks occur on southern slopes of low hills and on the sunny sides of stands in flat country. For control, silvicultural practices that increase the resistance of the trees are recommended.

57. LEAPHART, CHARLES D., and ROBERT E. DENTON. 1961. Needle discolorations of western larch. USDA For. Serv. For. Pest Leafl. 61, 7 p. Washington, D.C.

Five causes of larch needle discoloration are discussed: normal physiological processes, fungus diseases, climatic abnormalities, noxious fumes, and insects.

58. LONG, GARRELL E. 1977. Spatial dispersion in a biological control model for larch casebearer (*Coleophora laricella*). Environ. Entomol. 6:843-852.

A parasite-host model, developed for the *Agathis pumila-C. laricella* interaction and extended to include reproductive and dispersal rates, predicts that *A. pumila* can control *C. laricella* over a 50 mi^2 (129.5 km^2) area within 8 years.

59. LOOS, CURT. 1891. Einige Beobachtungen über *Coleophora laricella* auf dem Schluckenauer Domänengebiete. (Some observations on larch casebearer in the Schluckenauer Domänen region.) Centralbl. ges. Forstwes. 17:375-379.

General observations are given on the life history and habits of the larch casebearer.

60. LOOS, CURT. 1892. Einige Beobachtungen über *Coleophora laricella* Hbn. auf dem Schluckenauer Domänengebiete. (Some observations on larch casebearer in the Schluckenauer Domänen region.) Centralbl. ges. Forstwes. 18:423-431.

A continuation of the observations on the larch casebearer cited above, but in more detail.

61. LUITJES, J. 1971. Lariksmot op douglas. (Larch casebearer on young Douglas-fir.) Nederlands Bosbouw Tijdschr. 43(1):21-24.

This investigation of the development of larch casebearer on young Douglas-fir planted under a 35-year-old stand of Japanese larch gives numbers of eggs and densities of larvae per 100 needles.

62. LYON, ROBERT L., and MARGARET E. MAY. 1970. Toxicity of aerosols to larch casebearer larvae. USDA For. Serv. Res. Note PSW-208, 3 p. Pac. Southwest For. and Range Exp. Stn., Berkeley, Calif.

Six aerosol insecticides were tested in the laboratory against larch casebearer larvae. Their toxicity was determined by both direct contact and residual contact on filter paper. All six were highly toxic at less than 1.05 µg/cm^2 (the equivalent of 1.5 oz/acre (105.1 g/ha)). In decreasing order of toxicity at LD_{90} (lethal dosage for 90 percent mortality on direct contact) the insecticides were: Zectran, malathion, Sumithion (0.24-0.26 oz/acre (16.8-18.3 g/ha)), pyrethrins, Matacil (0.45-0.50 oz/acre (31.6-35.1 g/ha)), and Gardona (1.4 oz/acre (98.1 g/ha)). A dosage of 2 oz/acre (140.0 g/ha) is suggested for field trial of the three most toxic materials.

63. McGUGAN, B. M., and H. C. COPPEL. 1962. A review of the biological control attempts against insects and weeds in Canada. Part 11: Biological control of forest insects, 1910-1958. Tech. Commun. 2, Commonw. Inst. Biol. Control, Trinidad, 216 p.

Includes Canada's parasite introduction program for controlling larch casebearer.

64. McMILLIAN, W. D., and J. H. BORDEN. 1974. Evidence of a sex pheromone in the larch casebearer, *Coleophora laricella*. Environ. Entomol. 3(2):360-361.

Field experiments with baited traps in British Columbia showed evidence of a sex pheromone in the casebearer. Strong male response suggests that mass trapping or confusion control programs may be possible with the development of a synthetic pheromone.

65. MALENOTTI, E. 1924. Gli endofagi indigeni contro la *Coleophora laricella* (Conviene proprio aiutarne la diffusione?) (Indigenous endophagous parasites against the larch casebearer. Is it really advisable to encourage their diffusion?) L'Italia Agricola, p. 427-432.

During an outbreak of the larch casebearer in the province of Brescia, Italy, tests indicated that any wire gauze with a square mesh of 1, 1.33, or 1.66 mm width will permit the escape of the parasites of this moth. Permitting the parasites to escape from collected pupae, even if done at a cost equal to the estimated losses, only slightly assists the control of the casebearer because the collected pupae can only represent about 10 percent of the total number of casebearers.

66. MALENOTTI, E. 1935. Un problema di estetica montana: la coleofora del larice. (A problem of mountain beauty: the larch casebearer.) Atti Accad. Verona 13:153-158.

The decorative value of larch in Alpine resorts in Italy was impaired when an infestation by *Coleophora laricella* resulted in a gray and yellowish discoloration of the needles. Control was achieved on larches that were experimentally sprayed with a 5 percent tar distillate up to a height of about 25 to 31 ft (7.6 to 9.4 m) in January 1935.

67. MARTI, F. 1880. Die Lärchen-Miniermotte im Berner Oberland. (The larch casebearer in Berner Oberland.) Schweiz. Z. f.d. Forstwesen, p. 29-32.

Observations were made on the casebearer's behavioral habits in regard to feeding and selecting sites for overwintering. Severe winter cold did little harm to the casebearer once it began its winter diapause, but frost and rain during the spring feeding stage were harmful. Birds were important predators.

68. MASUTTI, LUIGI. 1961. I principali insetti dannosi alle conifere nelle valli del t. Torre e del t. Vegliato (Prealpi Giulie). (The principal conifer-damaging insects in the Torre and the Vegliator valleys (Giulia Foothills)). Collana "Tesi DiLaurea" 4:10-38.

A detailed account is given of the larch casebearer's life history and habits as observed in Italy.

69. MILLER, GORDON E., and THELMA FINLAYSON. 1974. Native parasites of the larch casebearer, *Coleophora laricella* (Lepidoptera: Coleophoridae), in the West Kootenay area of British Columbia. J. Entomol. Soc. B.C. 71:14-21.

Thirty-two species of parasites and hyperparasites were reared in 1973 from a total of almost 103,000 larch casebearers collected at eight locations in the West Kootenay area of British Columbia. The highest casebearer populations were found at Fruitvale and Shoreacres, with densities of 150 and 130 cases per 100 fascicles, respectively. The highest incidence of parasitism was 17.7 percent at Rossland, where the host density was just under 100 cases per 100 fascicles. The *Dicladocerus* spp. complex comprised 40.7 percent of the total parasitism and was abundant at Rossland, Arrow Creek, Christina Lake, Sheep's Creek, and Yahk; *Spilochalcis albifrons* comprised 23.6 percent of the total and was the most abundant parasite at Shoreacres, Christina Lake, and Fruitvale; and *Bracon pygmaeus* comprised 6.8 percent of the total and was the most abundant parasite at Anarchist Summit.

70. NEEDHAM, J. G., S. W. FOREST, and B. H. TOTHILL. 1928. Larch casebearer. *In* Leaf mining insects, p. 144-147. The Williams and Wilkins Co.

Recounts the larch casebearer's life history in eastern United States.

71. PATCH, EDITH M. 1906. Notes on insects; Larch case-bearer, *Coleophora laricella* Hbn. Maine Agric. Exp. Stn. Bull. 134:218-220.

Records the presence of larch casebearer over a large area of Maine and gives its life history.

72. PEIRSON, H. B. 1927. Larch casebearer. *In* Manual of forest insects. Maine For. Serv. Bull. 5, p. 76-78.

Describes the occurrence of the casebearer in Maine and recounts its life history.

73. POSTNER, M. 1963. Insektenschaden an der Larch ausserhalb ihred naturlichen Verbreitungsgebietes. (Insect damage on larch outside of its natural distribution range.) Forst-Wiss. Centralbl. 82:27-33.

Cultivation of larch (especially *Larix decidua*) outside of its natural range in the last 150-200 years has brought on many failures. Unfavorable climatic conditions and inadequate silvicultural measures followed by fungus disease and continual outbreaks of larch insects, especially the larch casebearer, *Coleophora laricella*, the larch sawflies, *Pristiphora erichsoni*, *P. wesmaeli*, *P. laricis*, and the larch thrips, *Taeniothrips laricivorus*, weakened the trees. Application of insecticides controlled the insects to some extent. The survival of larch grown outside of its natural range can only be attained by effective silvicultural measures.

74. PSCHORN-WALCHER, H. 1964. On the parasites of some injurious Lepidoptera from northern Japan. Commonw. Inst. Biol. Control Tech. Bull. 4:24-37.

A short review is given of parasite rearings conducted in northern Japan during the summer of 1961. The parasites of five forest insects, four orchard insects, and five field crop insects, all Lepidoptera, were investigated. The similarities between the parasite complexes of Lepidoptera in Japan and Europe are briefly outlined and discussed from an evolutionary point of view.

75. QUEDNAU, F. W. 1966. Notes on the life-history and morphology of *Chrysocharis laricinellae* (Ratzeburg) (Hymenoptera, Eulophidae), a parasite of the larch casebearer (Hubner). Ann. Entomol. Soc. Quebec 11(3):200-205.

The immature stages and life-history of *C. laricinellae*, when developing in *Coleophora laricella*, are described. Secondary sexual characters of the antenna are reported. Phenotypic variation in the coloration of the legs occurred as a result of different rearing temperatures.

76. QUEDNAU, F. W. 1967. Notes on mating behavior and oviposition of *Chrysocharis laricinellae* (Hymenoptera: Eulophidae), a parasite of the larch casebearer (*Coleophora laricella*). Can. Entomol. 99(3):326-331.

C. larcinellae mated readily in the laboratory when several individuals of both sexes were put together in a vial. The courtship dance performed by the male is described. Parasite females develop mature eggs 3 days after emergence and are apparently capable of resorbing the eggs if host casebearers are not available. Females can produce new eggs after host-feeding. Storage of eggs in the ovary for 5 months at 55°F (12.6°C) and sterility (phasic castration) of certain individuals is reported. Longevity at 75°F (23.8°C) of egg-laying females was about 1 month less than that of females that had not laid eggs because they did not contact hosts. Odor plays little or no role in the location of the larch casebearer larvae by *C. laricinellae*, but chemical surface stimuli on the surface of a mine or case of *C. laricella* seem to be important in locating the host. The parasite is also stimulated by vibrations of the host in its case. The oviposition and host-feeding pattern of *C. laricinellae* is described. Host-feeding on fourth-instar larvae of the larch casebearer contributed little to host mortality.

77. QUEDNAU, F. W. 1967. Ecological observations on *Chrysocharis laricinellae* (Hymenoptera: Eulophidae), a parasite of the larch casebearer (*Coleophora laricella*). Can. Entomol. 99(6):631-641.

An account is given of host acceptance, the influence of temperature on fecundity and longevity, and the searching capacity of *C. laricinellae*, a parasite of the larch casebearer. Fourth-instar case-bearing larvae were the preferred stages for attack. The size of the parasite progeny varied directly with the size of the host. Fecundity of progeny reared from small hosts was significantly less than that of progeny reared from large hosts. Not all parasite adults could successfully oviposit through the tough skin of the host pupa. *C. laricinellae* showed poor searching capacity. Superparasitism was common at low host densities of the casebearer and resulted either in only one parasite emerging or in total parasite mortality. A sex ratio where females predominated resulted when sufficient numbers of fourth-instar larvae were presented to mated *C. laricinellae*. The temperature threshold for attacking hosts was 55°F (12.6°C), and for development of the parasites 40°F (4.4°C). At 50°F (9.9°C) the adults lived an average of 4 months. *C. laricinellae* is able to survive in the field without alternate hosts and at very low host densities. The parasite seems to depend on a continuing supply and a sufficient quantity of suitable instars of host species to be effective. If *Coleophora laricella* is the only available host species in the ecosystem, the biological control value of this chalcid is rated as poor.

78. QUEDNAU, F. W. 1967. Notes on mating, oviposition, adult longevity, and incubation period of eggs of the larch casebearer, *Coleophora laricella* (Lepidoptera: Coleophoridae), in the laboratory. Can. Entomol. 99(4):397-401.

Mating in *C. laricella* took place 1 or 2 days after emergence and was stimulated by decreasing light intensity ranging from 3,000 to 200 fc (32,292 to 2,153 lm/m^2) within 2 hours. The female is pro-ovigenic, with peak oviposition during the first week. Optimum temperature for egg laying was 70° to 80°F (21° to 26.8°C), but a few eggs were laid at 50°F (9.9°C) and 95°F (34.9°C). The average number of eggs deposited was about

66. Average longevity of female adults was about 10 days at room temperature, but considerably longer at lower temperatures. Incubation period of the eggs was 12 days at 80° to 85°F (26.8° to 29.3°C) and 40 days at 55°F (12.6°C). Hatching of eggs did not occur above 85°F (29.3°C) or below 55°F (12.6°C).

79. QUEDNAU, F. W. 1968. Distribution and effectiveness of larch casebearer parasites in southwestern Quebec. Can. Bi-mon. Res. Notes 24(3):22-23.

Reports the distribution and effectiveness of two larch casebearer parasites, *Agathis pumila* and *Chrysocharis laricinellae*, in southwestern Quebec in 1967.

80. QUEDNAU, F. W. 1969. Laboratory propagation of the parasite *Chrysocharis laricinellae* (Hymenoptera: Eulophidae) and notes on interaction with its host, *Coleophora laricella*. Can. Entomol. 101(1):100-106.

A method for mass-rearing *C. laricinellae* on larch casebearer larvae, employing a water culture system for tamarack, is described. When the initial inoculum was 15 parasite females, the yield was about 100 healthy parasites from every 300 cases.

81. QUEDNAU, F. W. 1970. Competition and co-operation between *Chrysocharis laricinellae* and *Agathis pumila* on larch casebearer in Quebec. Can. Entomol. 102(5):602-612.

A. pumila and *C. laricinellae* compete for their common host, the larch casebearer. *A. pumila*, in sacrificing part of its own population, prevents a "one-stage condition" and helps *C. laricinellae* build up to a point where it becomes host-regulative by massive attack. Competitive displacement of *A. pumila* by *C. laricinellae* is less frequent than expected because of the different ways in which the two parasite species spread, search for, select, and attack hosts. *A. pumila* may suffer about 50 percent loss from multiple parasitism, but apparently this does not affect its survival potential, its reproductive rate, or its ability to provide significant partial control of the larch casebearer.

82. QUEDNAU, F. W. 1970. Notes on life-history, fecundity, longevity, and attack pattern of *Agathis pumila* (Hymenoptera: Braconidae), a parasite of the larch casebearer. Can. Entomol. 102(6):736-745.

A. pumila is a host-specific univoltine internal parasite attacking the first- and second-instar larvae of the larch casebearer. Descriptions and illustrations of all developmental stages are given. The adults mated in the laboratory when 1-day-old females were exposed to 5-day-old males. The maximum fecundity of *A. pumila* is more than 300 eggs, and in tests at 75°F (23.8°C) the average number of eggs laid per female was 139.8. Average longevity was 22.0 days. The average number of hosts destroyed with the ovipositor was 15.2 per female. The incubation period of the parasite's egg was 7 days at 77°F (25°C). The attack pattern of *A. pumila* is described. In finding hosts the parasite was guided by chemotaxis and vibrotaxis. Honey-fed *A. pumila* females, without hosts, were kept at constant temperatures ranging from 50° to 95°F (9.9° to 34.9°C). Longevity was, on the average, highest at 60°F (15.6°C) (45.6 days) and lowest at 95°F (34.9°C) (10.6 days). Superparasitism occurs in the field and laboratory.

83. RAIGORODSKAYA, I. A. 1966. Order Lepidoptera. *In* Pests of Siberian larch, p. 228,252-253, 351. A. S. Rozhkov (ed.) Acad. Sci. USSR. Sib. Dep. East-Sib. Biol. Inst. (Transl. from Russian). U.S. Dep. Agric. TT 70-50043, 393 p. Washington, D.C.

Describes insects infesting Siberian larch, with keys to species of the various families. Gives brief description of life stages and life history of *Coleophora dahurica* and *Coleophora sibirica*, illustrated with line drawings of life stages and genetalia. Suggests that damage by *C. dahurica* in some years affects 18 to 20 percent of the needles.

84. REISSIG. 1869. Die Lerchenmotte, *Coleophora laricella* Hb., *Tin. laricinella* Bchst. (The larch casebearer.) Z. f. Forst- u. Jagdwes. 1:129-137.

This is one of the earliest accounts of the life history of the larch casebearer and the nature of the damage it caused in Germany.

85. RUSH, PETER A. 1972. The larch casebearer (*Coleophora laricella*) population (LEPIDOPTERA: COLEOPHORIDAE) and its associated parasite complex on the Newcomb tract. M.S. (For. Entomol.) Thesis, Univ. Mich., Ann Arbor, 61 p.

Studies of the larch casebearer on the Newcomb Tract of the University of Michigan Forest in 1971 indicated the casebearer population was static or slightly increasing. Host tree provenances showed varying degrees of susceptibility and resistance to the casebearer. *Agathis pumila* and *Habrocytus phycidis* were the two most important parasites present.

86. RYAN, R. B. 1974. Laboratory reactivation of diapausing larch casebearer larvae following different lengths of winter exposure. USDA For. Serv. Res. Note PNW-218, 4 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Batches of field-collected diapausing larvae were transferred to a lab with a temperature of 68°F (20°C) between November and April. The number of days that elapsed before 50 percent of the larvae reactivated decreased from 28 in November to less than 1 in May. This relationship is useful in predicting reactivation of larvae for use in a laboratory rearing program.

87. RYAN, R. B. 1974. Attainment of the overwintering instar and the casebearing habit by larch casebearer larvae at different elevations in the Blue Mountains. USDA For. Serv. Res. Note PNW-228, 6 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

The percentage of larvae bearing cases increased between September 11 and October 25 from 2.6 to 93 percent on plots between 3,280- and 5,545-ft (1,000- and 1,690-m) elevation. Larvae at all elevations had reached the third (overwintering) instar by October 10. This information is useful in timing parasite release or insecticide applications. Larvae at 4,000 ft (1,219 m) advanced more rapidly than larvae at higher or lower elevations.

88. RYAN, R. B. 1975. Photoperiod effects on development of the larch casebearer, *Coleophora laricella* (Lepidoptera: Coleophoridae). Can. Entomol. 107:1305-1310.

Long-day (LD = 18 light:6 dark) and short-day (SD = 12 light:12 dark) photoperiodic treatments of various sequences and durations were applied to casebearing larvae at 68°F (20°C). Continuous development did not occur at either constant LD or SD. At LD, growth of young larvae was slow and was suspended in the late second or early third instar. At SD, young larvae developed rapidly but entered diapause in the late third instar. Pupation occurred when LD followed a period of SD. Timing and synchrony of pupation in a population were shown to be controllable by specific LD and SD sequences.

89. RYAN, R. B., W. E. BOUSFIELD, R. E. DENTON, R. L. JOHNSEY, L. F. PETTINGER, and R. F. SCHMITZ. 1975. Additional releases of larch casebearer parasites for biological control in the western United States. USDA For. Serv. Res. Note PNW-242, 7 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Reports the release of additional *Chrysocharis laricinellae* and four new parasites, *Necremnus metalarus*, *Elachertus argissa*, *Dicladocerus* "A," and *Diadegma laricinella*, for biological control of the larch casebearer in Washington, Idaho, and Montana.

90. RYAN, R. B., W. E. BOUSFIELD, C. W. JOHANNINGMEIER, G. B. PARSONS, R. F. SCHMITZ, and L. J. THEROUX. 1977. Releases of recently imported larch casebearer parasites for biological control in the western United States, including relocations of *Agathis pumila*. USDA For. Serv. Res. Note PNW-290, 8 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Releases of *Chrysocharis laricinellae, Dicladocerus westwoodii, Dicladocerus japonicus, Elachertus argissa, Necremnus metalarus* (all, Hymenoptera: Eulophidae), and *Agathis pumila* (Hymenoptera: Braconidae), for biological control of the larch casebearer in Washington, Oregon, Idaho, and Montana included some newly imported stocks and additional release locations.

91. RYAN, ROGER B., WAYNE E. BOUSFIELD, GORDON E. MILLER, and THELMA FINLAYSON. 1974. Presence of *Chrysocharis laricinellae*, a parasite of the larch casebearer in the Pacific Northwest. J. Econ. Entomol. 67(6):805.

Reports the discovery of *C. laricinellae* in northern Idaho and southeastern British Columbia in 1972 and 1973, respectively.

92. RYAN, R. B., and R. E. DENTON. 1973. Initial releases of *Chrysocharis laricinellae* and *Dicladocerus westwoodii* for biological control of the larch casebearer in the western United States. USDA For. Serv. Res. Note PNW-200, 4 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Totals of 240 *C. laricinellae* and 513 *D. westwoodii* (Hymenoptera: Eulophidae) from Austria and England were released in Washington and Idaho in 1972. This was the first attempt at establishing these parasites for biological control of the larch casebearer in western North America.

93. RYAN, R. B., and C. M. YOSHIMOTO. 1975. Laboratory crossings with different sources of the larch casebearer parasite *Chrysocharis laricinellae* (Hymenoptera: Eulophidae). Can. Entomol. 107:1301-1304.

C. laricinellae from Austria, Sweden, England, and Wisconsin, some of which may be different species, were crossed. Hybrid sex ratios in this arrhenotokous species were similar to parental types, indicating conspecificity. English and Wisconsin strains tended toward darker legs and female scapes.

94. SCHAFFNER, J. V., JR. 1937. The larch case-bearer (*Coleophora laricella* Hbn.). Mass. For. and Park Assoc. Tree Pest Leafl. 12, 3 p.

Briefly reports the larch casebearer's distribution, life history, injury to trees, and control in the New England States.

95. SCHAFFNER, J. V., JR. 1952. Larch case-bearer (*Coleophora laricella*). Mass. For. and Park Assoc., Tree Pest Leafl. 12, 1937 (Rev.). Publ. under: Baldwin, H. I., and others, Important tree pests of the Northeast, 2nd ed., 1952, p. 17-20. Evans Printing Co., Concord, N.H.

Recounts information reported in Tree Pest Leaflet No. 12, 1937, with minor revisions.

96. SCHAFFNER, J. V., JR. 1959. Microlepidoptera and their parasites reared from field collections in the northeastern United States. U.S. Dep. Agric. Misc. Publ. 767, 97 p. Washington, D.C.

Lists 32 species of hymenopterous parasites reared from larch casebearers from 87 collections in Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New York, and New Jersey.

97. SCHELLER, H. D. 1957. Versuche zur Bekämpfung von *Coleophora laricella*. Ein Beitrag zur Wirkung von Kontaktinsektiziden auf die Kronenfauna. (Tests on the control of the larch casebearer. A contribution to the effect of contact insecticides on the crown fauna.) Anz. Schädlingsk. 30(12):203-207.

A dust containing 2 percent methyl-parathion applied in September resulted in more than 90 percent casebearer mortality. Mortality of other arthropods present in the tree crowns was noted.

98. SCHIMITSCHEK, ERWIN. 1966. Über Ursachen der Befallsbereitschaft für Nadelfresser der Lärche in ihren natürlichen Verbreitungsgebiet. (Susceptibility to defoliating insects of larch within its natural range.) Centralbl. ges. Forstwes. 83(1):1-23.

Analyzes site factors of larch stands, mainly in Tirol, Austria, subject to attack by *Semasia diniana* and *Coleophora laricella*. Studies indicated that, as a result of a long grazing history, the soils under these stands had poor aeration, slow seepage, and frequently low microfaunal densities. Pure, open stands were more susceptible than closed or mixed stands. Susceptible trees tended to have lower sap-stream velocities.

99. SCHINDLER, U. 1965. Zur Bekämpfung der Lärchenminiermotte. (The control of the larch casebearer.) Forst Holzw. 20:348-353.

Infestation by *Coleophora laricella*, which declined in northwestern Germany after reaching a peak in the mid 1950's, increased again from 1963 onward. Investigations on chemical control of the casebearer were conducted in 1963-64 with a number of chemicals. Results showed that a larval density of 1 per 5 fascicles represented a threat to the trees, but chemical control was effective and longlasting. With increasing or heavy infestation, treatment should be carried out against the young larvae in the summer or early autumn with materials having some systemic effect. In a treatment applied from the ground, a parathion dust at 18 lb per acre (20 kg/ha) gave almost complete control and was recommended. Aerial treatment with dimethoate (as Roxion) gave good control at a rate of 0.09 gal insecticide in 6.3 gal liquid per acre (0.84 liter in 59 liters/ha). When infestation is beneath the critical level but treatment is considered necessary, chemicals should be applied against the full-fed larvae in the spring. Of the materials tested, all the phosphorus compounds gave 95 to 100 percent reduction in infestation, and diazinon or dimethoate, which are relatively mild but quick acting, were recommended.

100. SCHINDLER, ULRICH. 1968. Massenwechsel eines typischen forstlichen Dauerschädlings, der Lärchenminiermotte *Coleophora laricella*. (Population change in a typical perennial forest pest, the larch casebearer.) Z. f. Angew. Entomol. 61(4):380-386.

The outbreak of larch casebearer in larch cultivations in northwestern Germany lasted about 12 years. High population densities occurred from 1952 to 1957, followed by a decrease until 1962. Populations began to increase again in 1964. Parasitism, mostly by Chalcididae, was dependent on weather and host density.

101. SCHINDLER, U. 1971. Control of forest insects by ultra-low volume spraying. Plant Prot. Organ. Bull. O. E. No. 2, p. 49-55.

Chemical control trials carried out from 1967 to 1969 against 11 forest insect pests gave good results with ultra-low volume concentrates of malathion, dimethoate, and bromophos-ethyl. Motorized knapsack sprayers were used, but a helicopter spraying with 1,500 cc/ha of malathion against larvae of *Coleophora laricella* was also made in August 1968. Both methods resulted in protecting trees from significant defoliation.

102. SCHINDLER, ULRICH. 1972. Einfluss der Meisen (Paridae) auf die Populationsdichte der Lärchenminiermotte (*Coleophora laricella* Hbn.) im Kalamitätsgebiet des Emslandes. (Influence of tits on the population density of larch casebearer.) Allg. Forst- u. Jagdztg. 143(1):17-20.

An experiment providing nesting sites for tits and evaluating their influence on the population density of larch casebearer is described. Findings indicated that the tits were successful in reducing the density of larch casebearer below the threshold of economic damage.

103. SCHMIDT, WYMAN C., RAYMOND C. SHEARER, and ARTHUR L. ROE. 1976. Ecology and silviculture of western larch forests. U.S. Dep. Agric. Tech. Bull. 1520, 96 p.

Summarizes and consolidates ecological and silvicultural knowledge of western larch forests, with a section on the larch casebearer as a serious pest of western larch.

104. SCHOBER, REINHARD. 1953. Die japanische Lärche, eine biologisch-ertragskundliche Untersuchung. (The Japanese larch, a biological and productive investigation.) Schriftenreihe Forstl. Fakultät u. Mitteil. Niedersächs. Forstl. Versuchsanst. 7/8, 212 S., Frankfurt (Sauerländer).

The viewpoint, repeatedly expressed in the literature, that Japanese larch is less often attacked by larch casebearer than European larch could not be supported by observations in Germany and Holland.

105. SCHÖNWIESE, FRITZ. 1937. Einige Beobachtungen über das Auftreten und den Parasiten-Befall der Lärchenminiermotte. (Some observations on occurrence and parasitism of the larch casebearer.) Centralbl. ges. Forstwes. 63:312-316.

From May to July the rearing of parasite species from 100 casebearers produced 43 *Chrysocharis laricinellae*, 26 *Microdus pumilus*, and 6 *Pteromalus semiclavatus*. Parasites reared from material collected from 1934 to 1936 from various parts of Austria included the above and, in addition, *Gelis (Pezomachus) laricellae*, *Hemiteles albipalpus* var. *austriacus* n.sp., *H. pulchellus*, *Cirrospilus (Entedon) pictus* var. *arcuatus*, and *Necremnus leucarthros*. *Necremnus* and *Pteromalus* had not previously been reared from the casebearer.

106. SCHREMMER, FRITZ. 1959. Beobachtungen und Untersuchungen über die Insektenfauna der Lärche (*Larix decidua*) im östlichen Randgebiet ihrer natürlichen Verbreitung, mit besonderer Berücksichtigung einer Grosstadtlärche. (Observation and investigations on the insect fauna of larch on the eastern edge of its natural area of distribution, with particular reference to a city-growing larch.) Z. f. Angew. Entomol. 45(1):1-48.

From 1954 to 1956, investigations were carried out on the arthropod fauna of larch (*Larix decidua*) at four localities in Austria. The results are discussed in detail, and the species observed, including larch casebearer, are listed in a table showing the areas in which each species occurred.

107. SCHWARZ, HANS. 1933. Neue Schädlinge der Douglasie. (New pests of the Douglas-fir.) Z. f. Pflanzenkr. und Planzenschutz 43:417-418.

Larch casebearer was listed among the insects feeding on Douglas-fir near Vienna.

108. SCHWENKE, WOLFGANG. 1958. Über die Standortabhängigkeit des Massenwechsels der Lärchenminiermotte, *Coleophora laricella* Hb., und der Ahorneule, *Acronycta aceris* L. (The dependence of the mass fluctuation in the larch

casebearer, *Coleophora laricella* Hb., and in the maple noctuid, *Acronycta aceris* L., on their location.) Beitrz. z. Entomol. 8(3/4):241-290.

Results are given of an investigation concerning the population density and some of the factors controlling the density of the larch casebearer (*Coleophora laricella*) and the noctuid *Acronycta aceris* at different localities.

109. SCHWERDTFERGER, F., and G. SCHNEIDER. 1957. Über den Einfluss von Lärchenminiermotte Frass auf Benadelung und Zuwachs der Lärche. (The influence of larch casebearer damage on the foliage and growth of larch trees.) Forstarchiv 28:113-117.

Half of a larch stand was treated to eliminate the casebearer, and growth comparisons were made with the untreated portion for a 3-year period. Needle growth diminished between 35 and 60 percent and diameter growth diminished between 33 and 45 percent in the untreated portion of the stand.

110. SINDELAR, JIRI, and RICHARD HOCHMUT. 1972. Variability in the occurrence of some insect pests on various provenances of European larch *Larix decidua* Mill. Silvae Genet. 21(3-4):86-93.

The degree of infestation of *Larix decidua* by *Coleophora laricella* was broken down by provenance. There was a strong negative correlation with earliness and rapidity of needle flushing. A positive correlation was indicated with regard to essential oils in needles and shoots. Infestation of the one provenance of *Larix leptolepsis* was much lower than that of all the provenances of *Larix decidua*.

111. SKUHRAVÝ, VÁCLAV. 1973. Field control of the larch case-bearer moth, *Coleophora laricella*, with a juvenoid. Acta Entomol. Bohemoslov. 70(5): 313-322.

An aqueous emulsion of the juvenoid ethyl 3, 7, 11-trimethyldodeca-2, 4-dienoate was used for control against fourth-instar larvae of *C. laricella* under field conditions on plots of 100 and 300 m^2. A concentration of 0.1 percent caused 96 percent mortality in the field and 87 to 98 percent mortality in laboratory rearings of material collected in the field. A 0.01 percent concentration resulted in 34 to 35 percent mortality in the field, and 40 to 60 percent mortality for material brought from the field and reared in the laboratory. Problems of utilization of the juvenoid in the control of this pest are discussed.

112. SKUHRAVÝ, VÁCLAV. 1976. The effectiveness of two juvenoids on *Coleophora laricella* (Lepidoptera) in a field experiment. Acta Entomol. Bohemoslov. 73(1):59-60.

Two juvenoid compounds, with activity similar to that of juvenile hormones effective against other lepidopterous larvae, resulted in 86 to 93 percent and 47 to 66 percent malformed casebearer pupae. Both compounds prolonged the larval stage.

113. SLOAN, NORMAN FREDERICK. 1965. Biotic factors affecting populations of the larch casebearer, *Coleophora laricella* Hbn., in Wisconsin. Ph.D. Thesis, Univ. Wisc., Madison, 193 p.

Reports a study of the bionomics of *C. laricella* and its principal parasite *Agathis pumila*. Thirteen of the 93 parasites recorded for *C. laricella* were reared from collections made in Wisconsin. Only five of these (*A. pumila*, *Bracon pygmaeus*, *Gelis tenellus*, *Habrocytus phycidis*, and *Kratochviliana laricinellae*) proved to exercise any degree of control in local areas; *A. pumila* was responsible for 60 to 70 percent of the mortality caused by parasites in two areas studied. Studies in the field and in

the laboratory showed that bird predation caused a considerable drop in populations of *C. laricella* in spring and that *Parus atricapillus*, *Regulus calendula*, *Dendroica magnolia*, and *D. petechia* were the most important of the 32 bird species studied.

114. SLOAN, NORMAN F., and HARRY C. COPPEL. 1964. A technique for the laboratory observation of bird predation. Proc. North Central Br., Entomol. Soc. Am. 19:63-64.

A one-way mirror was used for laboratory observation of bird predation on the larch casebearer.

115. SLOAN, NORMAN F., and HARRY C. COPPEL. 1964. An entomology research project in the arboretum--larch casebearer. Univ. Wisc., Madison, Arbor. News 13:2-3.

Preliminary results of investigations begun in 1961 at the University of Wisconsin arboretum involving caged and uncaged larch trees indicated that a combination of bird and insect predators and insect parasites achieved the best control of the larch casebearer.

116. SLOAN, NORMAN F., and HARRY C. COPPEL. 1965. Population fluctuations of the larch casebearer, *Coleophora laricella* Hbn. in the University Arboretum, Madison, Wisconsin, 1962-1964. Univ. Wisc. For. Res. Notes 122, 3 p.

Seasonal fluctuations in casebearer populations were recorded and a model life equation was developed. In this instance, beginning with one female, there was a 35 percent population increase in one generation.

117. SLOAN, NORMAN F., and HARRY C. COPPEL. 1965. Seasonal history and parasite complex of the larch casebearer, *Coleophora laricella* Hbn. in Wisconsin. Univ. Wisc. For. Res. Notes 123, 6 p.

Of the 15 species of hymenopterous parasites reared from the casebearer in Wisconsin, only five are important: the introduced species *Agathis pumila* and *Kratochviliana laricinellae*, and the native *Bracon pygmaeus*, *Gellis tenellus*, and *Hybrocytus phycidis*.

118. SLOAN, NORMAN F., and HARRY C. COPPEL. 1965. Oviposition patterns and egg predation of the larch casebearer, *Coleophora laricella* Hbn. in Wisconsin. Univ. Wisc. For. Res. Notes 124, 4 p.

Results of three separate studies showed (1) the casebearer could not survive on coniferous species other than *Larix*, (2) the majority of eggs were laid in the upper and middle portions of larch crowns, and (3) no egg parasites were found, but predation by the mirid *Derasocoris* sp. amounted to 22 percent.

119. SLOAN, NORMAN F., and HARRY C. COPPEL. 1965. The insect parasites of the larch casebearer, *Coleophora laricella* Hübner, (Lepidoptera: Coleophoridae), in Wisconsin with keys to the adults and mature larval remains. Wisc. Acad. Sci., Arts and Lett. 54:125-146.

Fifteen species of parasites of *C. laricella* have been reared in Wisconsin. Two keys were prepared to aid in separation of adult parasites and of parasite remains left in the host case. Nine species of parasites are included in each of the keys. Brief notes on the biology of each species, and illustrations and descriptions of the final-instar cephalic structures are given.

120. SLOAN, NORMAN F., and HARRY C. COPPEL. 1968. Ecological implications of bird predators on the larch casebearer in Wisconsin. J. Econ. Entomol. 61(4): 1067-1070.

Birds are important predators of the casebearer in Wisconsin. Population decline of the casebearer in the winter, probably attributable to birds, was 23.5 percent, of which 30 to 40 percent was calculated to consist of nonparasitized larvae. Predation by birds between April and June caused a significant loss in prey population, although many of the larvae eaten were parasitized. Apparently birds did not discriminate between parasitized and nonparasitized larvae. Feeding activity in the spring was three times that recorded in the fall, under laboratory conditions, and probably reflected the "specific feeding image" developed by the birds for the larger and more active spring larvae. The magnolia warbler, *Dendroica magnolia*; the yellow warbler, *D. petechia*; the ruby-crowned kinglet, *Regulus calendula*; and the black-capped chickadee, *Parus atricapillus*, exhibited the most frequent feeding responses to the larch casebearer. No instances of "clipped-off" cases were observed in the laboratory feeding trials or in the field. Birds swallowed both case and larva completely except for the black-capped chickadee, which in the spring removed the case from the tree, extracted the larva, and then dropped the case to the ground.

121. SWAINE, J. M. 1933. Insect activities. For. Chron. 9(4):11.

Reports severe infestations of larch casebearer from Nova Scotia and Maine to central Ontario.

122. TAKAGI, G. 1932. (New forest pest in Korea.) Chosen Sanrinkwaihô 94:42-49. (Abstr. in Jap. J. Zool. 5(2):6 (1933).)

An account is given of the distribution, morphology, life history, and natural enemies of *Coleophora laricella* on two species of larch (*Larix dahurica* var. *coreana* and *L. kaempferi*) in Korea. The injury it causes and the control measures adopted are discussed.

123. THALENHORST, WALTER. 1953. Zur Bekämpfung der Lärchenminiermotte. (The control of the larch casebearer.) Holz-Zentralbl. 79(81):893-894.

Several insecticides, applied as dusts or as fog solutions, gave varying degrees of success in controlling the larch casebearer.

124. THEOBALD, FRED. V. 1904. The larch *Coleophora* or leaf miner (*Coleophora laricella*, Hubner). Gardeners' Chron. 36:181-182.

Reports the presence of the larch casebearer in Britain with a description of its life history and habits.

125. THORPE, W. H. 1933. Notes on the natural control of *Coleophora laricella*, the larch case-bearer. Bull. Entomol. Res. 24:271-291.

Reports on preliminary investigations of the parasites of *C. laricella* in Europe, with a view to possible utilization of these parasites in Canada. Systematic and biological notes on the more important species are given.

126. TRÄGÅRDH, IVAR. 1910. Lärkträdsmalen (*Coleophora laricella* Hübn.). (The larch casebearer). Entomol. Tidskr. 31(4):258-264.

A description is given of the casebearer's life stages, life history, and the nature of its damage to larch in Sweden.

127. TRÄGÅRDH, IVAR. 1915. Försök med svavelkalkvätska mot lärkträdsmalen. (Experiments with lime-sulphur against the larch casebearer). Centralanst. för Jordbruksförsök, Flygblad 49, Stockholm, Entomol. Avd. 11, 3 p.

A lime-sulphur spray was used to control the larch casebearer in the vicinity of Stockholm. Examination showed that 13 percent of the needles were attacked on sprayed trees, while on unsprayed trees 67 percent of the needles were destroyed. The experiment was repeated the following year with the sprayed trees showing 0.24 percent of their needles attacked, while unsprayed trees had 50 to 60 percent of their needles attacked.

128. TUNNOCK, SCOTT, ROBERT E. DENTON, CLINTON E. CARLSON, and WILLIS W. JANSSEN. 1969. Larch casebearer and other factors involved with deterioration of western larch stands in northern Idaho. USDA For. Serv. Res. Pap. INT-68, 10 p. Intermt. For. and Range Exp. Stn., Ogden, Utah.

In northern Idaho, dead and dying trees were found in stands of western larch that had been defoliated severely by larch casebearer during periods ranging from 4 to 10 years. Examinations determined the extent that larch casebearer and other factors contributed to this deterioration. Beetles were found in 11 of the 72 dead or dying trees sampled. Western larch borer was collected from nine trees and scavenger beetles from the other two. In only six trees was the borer abundant enough to be a factor in causing mortality. Root rot was detected in 14 of the 72 trees and could have contributed to the death of several. Tree deterioration showed no correlation with soil series or soil fertility. This study did not confirm that larch casebearer was the sole cause of tree mortality; however, larch casebearer is definitely responsible for weakening and predisposing western larch stands to mortality.

129. TURNBULL, A. L., and D. A. CHANT. 1961. The practice and theory of biological control of insects in Canada. Can. J. Zool. 39:697-753.

The success or failure of each of 31 Canadian biological control projects is assessed. Past experiences in Canada are analyzed, and recommendations for future work are made. There is a discussion on the philosophy of biological control and some of the popular misconceptions regarding it. Some possible dangers of biological control are mentioned.

130. VITÉ, J. P. 1954. Die Lärchenminiermotte, zur Frage des Schadens und der Gegenmassnahmen. (The larch casebearer, the question of damage and countermeasures.) Holz-Zentralbl. 80:1065-1067.

Describes the life history of the casebearer in Germany, the damage it inflicts on larch trees, and possibilities for biological and chemical control.

131. VITÉ, J. P. 1955. Der Versuch einer gleichzeitigen Bekämpfung von Blasenfuss und Lärchenminiermotte, seine Grundlagen und Aussichten. (The attempt to control thrips and larch casebearer simultaneously: its bases and prospects.) Höfchen-Briefe 8:35-53.

Descriptions are given of larch thrips and larch casebearer, the damage that each insect inflicts on larch, and methods of individual control of each insect. A 5 percent concentration of the systemic insecticide Metasystox, applied by the bandage method in early July, gave complete control of both insects.

132. VOUTE, A. D. 1952. Aantasting van Douglas door de lariksmot (*Coleophora laricella* Hb.). (Attacks of the larch casebearer (*Coleophora laricella* Hb.) on Douglas-fir.) Ned. Boschb.-Tijdschr. 24:244.

Casebearer larvae were found feeding on needles of young Douglas-fir. Information is not given as to whether the larvae completed their development.

133. WACHTENDORF, WOLFGANG. 1955. Über die Bekämpfung der Lärchenminiermotte. (On the control of the larch casebearer.) Anz. Schädlingsk. 28:101-102.

Complete control of the casebearer was achieved using backsprayers to apply sprays of Systox and Metasystox at concentrations of 0.05 percent. Control was equally good whether spraying was done in the spring or fall.

134. WASHBURN, RICHARD I., R. LADD LIVINGSTON, and GEORGE P. MARKIN. 1977. An aerial test of orthene against the larch casebearer. USDA For. Serv. Res. Note INT-226, 6 p. Intermt. For. and Range Exp. Stn., Ogden, Utah.

Orthene, a systemic insecticide, proved effective against the needle mining stage of the casebearer when applied at the rate of 1 lb orthene/gal/acre (1.2 kg/9.35 liters/ha). The casebearer population reduction due to the spray averaged 97.2 percent.

135. WEBB, FRANK E. 1950. Biology of the larch casebearer, *Coleophora laricella* Hübner, in New Brunswick. M.S. (For.) Thesis, Univ. Mich., Ann Arbor, 58 p.

Reports the first in-depth study in North America of the casebearer's morphology, its life history and development, the damage caused, and natural control factors.

136. WEBB, F. E. 1952. The larch casebearer in the Maritime Provinces and Great Lakes region. Can. Dep. Agric. Bi-mon. Progr. Rep. 8(1):1.

Reports the duration of larch casebearer outbreaks and some biotic control factors in the Maritime Provinces and Great Lakes region.

137. WEBB, FRANK ERNEST. 1953. An ecological study of the larch casebearer. Ph.D. Thesis, Univ. Mich., Ann Arbor, 210 p.

Results are given of the most comprehensive study made in North America of the casebearer.

138. WEBB, F. E. 1957. Sampling techniques for the overwintering stage of the larch casebearer. Can. Dep. Agric. Bi-mon. Progr. Rep. 13(4):1-2.

Reports the progress in developing sampling methods for the overwintering life stage of the larch casebearer in New Brunswick, Canada.

139. WEBB, F. E., and R. E. DENTON. 1963. Larch casebearer, *Coleophora laricella* (Hbn.). *In* Important forest insects of mutual concern to member countries of the North American Forestry Commission, p. 15-17. Compiled by Working Group on Forest Insects and Diseases, North Am. For. Comm., F.A.O.

Reviews the history, nature of damage, and control measures for the casebearer in North America.

140. WEBB, F. E., and R. E. DENTON. 1967. Larch casebearer, *Coleophora laricella* (Hbn.). *In* Important forest insects and diseases of mutual concern to Canada, the United States and Mexico, p. 58-88. Can. Dep. For. and Rural Develop.

Revises and updates the information given in 1963.

141. WEBB, F. E., and F. W. QUEDNAU. 1971. *Coleophora laricella* (Hübner), larch casebearer (Lepidoptera: Coleophoridae). *In* Biological control programmes against insects and weeds in Canada, 1959-1968, p. 131-136. Tech. Comm. No. 4, Commonw. Inst. Biol. Control.

Reviews the history of the larch casebearer in North America, with sections on releases and recoveries of casebearer parasites and evaluations of biological control attempts.

142. WEBER, TRUTZ. 1966. Abweichungen in der Entwicklung der Lärchenminiermotte, *Coleophora laricella* Hb. (Anomalies in the development of the larch casebearer.) Anz. Schädlingsk. 39(5):72-73.

Experiments on potted larches with larvae at different stages of development showed that, under certain conditions, larvae can pupate prematurely and adults can emerge in the autumn of the year of oviposition. It seems likely that larval diapause is induced by external factors that are not yet known.

143. WEBER, T. 1966. Lässt sich das Einbandverfahren zur Bekämpfung der Lärchenminiermotte mittels systemischer Insektizide durch einfache Stammspritzung ersetzen? (Can the bandage method of controlling the larch casebearer with systemic insecticides be replaced by stem spraying?) Der Forst- und Holzwirt 21(8):182-184.

Describes tests with various insecticides sprayed to a height of 10 ft (3 m) on Japanese larch not more than 23 ft (7 m) tall in (a) early July, just before egg hatch, and (b) late July, when leaf-mining started. One percent Metasystox applied in (b) was the only pesticide that gave good control to 23 ft (7 m). Costs and labor requirements of stem spraying were about half those of the bandage method.

144. WIACKOWSKI, STANISLAW, JOZEF CHLODY, MAREK TOMKOW, MACIEJ WITRYLAK, and ADREZEJ KOLK. 1976. Studies on entomofauna of larch, alder and birch in different environmental conditions and its ecological relationships with insect pests of more important forest tree species. For. Res. Inst. and Educ. Univ., Kielce. Warsaw, Krakow, Kielce, 142 p.

Investigations of the insect fauna of European larch and other tree species are reported. A total of 95 insect species was collected from larch, including 67 phytophagous species, 13 parasitic species, 10 predaceous species, and 5 species feeding on the plant as well as animal foods. *Agathis pumila* and *Diadegma nana* were the only parasites found to be locally effective in reducing the casebearer population.

145. WITZGALL. 1955. Beobachtungen zur Bekämpfung der Lärchenminiermotte. (Observations on the control of the larch casebearer.) Allgem. Forst Z. 10:400.

Observations made for a period of several days suggested that birds are important predators on casebearer larvae in the spring.

146. YANO, M. 1919. Jurai Honpo ni oite Daihassei o naseru Shinrin-Gaichu n. tsuite. (Injurious forest insects that have hitherto occurred in great abundance in Japan.) *In* Jap. Imperial For. Bur. Sanrin-Koho (Publ. For. Rep.) 6, p. 453-470. Tokyo, Japan.

Reports larch casebearer as being injurious to *Larix leptolepsis* in Japan.

147. YOSHIMOTO, CARL M. 1976. Revision of the genus *Dicladocerus* (Eulophidae: Chalcidoidea) of America north of Mexico, with particular reference to species attacking larch casebearer (Lepidoptera: Coleophoridae). Can. Entomol. 108:1173-1206.

The North American species of *Dicladocerus* are revised. Twelve new species from North America and one from Japan are described and illustrated: *alaskensis, australis, prealatus, occidentalis, exoteliae, epinotiae, betulae, vulgaris, nearcticus, pacificus, japonicus, westwoodii,* and *terraenovae*. The species attacking larch casebearer are *nearcticus, pacificus, terraenovae,* all Nearctic, and *japonicus* and *westwoodii*, both Palearctic. Relationships of species-groups in North America are discussed. A key to species is included, as are the host records.

SUBJECT INDEX

AUTHOR INDEX

APPENDIX

UNPUBLISHED REPORTS

BOUSFIELD, W. E. 1970. Parasite complex of the larch casebearer in the Northern Region. USDA For. Serv., North. Reg., Div. State and Priv. For., Missoula, Mont.

BOUSFIELD, W. E. 1972. Potential for larch casebearer defoliation in the Northern Region--1972. USDA For. Serv., North. Reg., Div. State and Priv. For., Rep. 72-6, 4 p.

BOUSFIELD, W. E., and R. C. LOOD. 1971. Impact of parasites on the larch casebearer in the Northern Region--1970. USDA For. Serv., North. Reg., Div. State and Priv. For., Rep. 71-4, 13 p.

BOUSFIELD, W., and S. TUNNOCK. 1969. Surveys of larch stands damaged by the larch casebearer within the Northern Region. USDA For. Serv., North. Reg., 5 p.

CIESLA, W. M., and W. E. BOUSFIELD. 1971. Potential for defoliation of western larch by larch casebearer in the Northern Region. USDA For. Serv., North. Reg., Div. State and Priv. For., Rep. 71-3, 6 p.

DAWSON, A. F. 1969. Larch casebearer studies in British Columbia. Can. For. Serv., Pac. For. Res. Cent., Victoria, B.C. (unpubl. rep.)

DENTON, R. E. 1958. Defoliating insects of western larch in the northern Rocky Mountains, 1957. USDA For. Serv., Intermt. For. and Range Exp. Stn. (Missoula For. Insect Lab.), 4 p.

DENTON, R. E. 1964. The larch casebearer in western larch forests: a problem analysis. USDA For. Serv., Intermt. For. and Range Exp. Stn., 24 p. Ogden, Utah.

DENTON, R. E. 1970. Larch casebearer in western larch forests: a problem analysis (revised). USDA For. Serv., Intermt. For. and Range Exp. Stn., 28 p.

DENTON, R. E. 1975. Larch casebearer in western larch forests: a problem analysis (revised). USDA For. Serv., Intermt. For. and Range Exp. Stn., 18 p.

OSTOFF, DON. 1972. A case history of larch casebearer. Simon Fraser Univ., Burnaby, B.C., 33 p. (*In* Pac. For. Res. Cent. Lab., Victoria, B.C.)

SCHMIDT, W. C., and R. E. DENTON. 1969. Study plan: relationship of larch casebearer populations to young western larch development under different stand densities, Coram Experimental Forest, Montana, 1969. USDA For. Serv., Intermt. For. and Range Exp. Stn., 11 p.

SHEPHERD, R. F., and D. A. ROSS. 1973. Problem analysis: larch casebearer in B.C. Can. Dep. Environ., For. Serv., Pac. For. Res. Cent., Victoria, B.C., Intern. Rep. BC-37, 22 p.

TERRELL, T. T. 1962. Larch casebearer in the Northern Region. USDA For. Serv., North. Reg., 2 p.

TERRELL, T. T. 1963. Larch casebearer in Idaho and Montana. USDA For. Serv., North. Reg., 2 p.

TERRELL, T. T., and R. E. DENTON. 1965. Introducing parasites to control larch casebearer in the Northern Region, 1964. USDA For. Serv., North. Reg., 20 p.

TERRELL, T. T., and R. E. DENTON. 1966. Biological control of the larch casebearer in the Northern Region, 1965. USDA For. Serv., North. Reg., 10 p.

TERRELL, T. T., and R. E. DENTON. 1966. Biological control of larch casebearer by parasites in the Northern Region, 1966. USDA For. Serv., North. Reg., 3 p.

TUNNOCK, S. 1962. Preliminary tests with lindane, malathion, and DDT insecticides applied by helicopter to control the larch casebearer in Idaho. USDA For. Serv., North. Reg., 9 p.

TUNNOCK, S. 1968. The larch casebearer problem in the Northern Region during 1967. USDA For. Serv., North. Reg., 3 p.

TUNNOCK, S. 1968. The establishment and natural spread of the larch casebearer parasite, *Agathis pumila*, in the Northern Region. USDA For. Serv., North. Reg., 6 p.

TUNNOCK, S. 1970. Progress report on a study to determine larch casebearer populations and damage at various elevations. USDA For. Serv., North. Reg., 5 p.

TUNNOCK, S. 1971. Larch casebearer infestations in the Northern Region--1970. USDA For. Serv., North. Reg., Div. State and Priv. For., Rep. 71-1, 2 p.

TUNNOCK, S. 1971. Spread of the larch casebearer infestation in the Northern Region--1971. USDA For. Serv., North. Reg., Div. State and Priv. For., Rep. 71-41, 2 p.

TUNNOCK, S. 1972. Observations on the decline of western larch defoliated by larch casebearer in the Northern Region. USDA For. Serv., North. Reg., Div. State and Priv. For., Rep. I-72-7, 4 p.

TUNNOCK, S., and W. BOUSFIELD. 1969. The spread of the larch casebearer in the Northern Region and attempts at biological control with *Agathis pumila*. USDA For. Serv., North. Reg., 10 p.

TUNNOCK, S., and F. W. HONING. 1967. Distribution of *Agathis pumila* for biological control of the larch casebearer in the Northern Region. USDA For. Serv., North. Reg., 7 p.

TUNNOCK, S., W. BOUSFIELD, and C. E. CARLSON. 1968. Surveys to detect and evaluate larch dieback in stands infested with the larch casebearer in the Northern Region. USDA For. Serv., North. Reg., 5 p.

TUNNOCK, S., K. W. KEEFE, and R. E. DENTON. 1964. Aerial pilot test using low volumes of undiluted malathion to kill larch casebearer larvae. USDA For. Serv., North. Reg., 6 p.

TUNNOCK, S., M. McGREGOR, and W. BOUSFIELD. 1972. Distribution of larch casebearer parasites in the crowns of western larch trees in the Northern Region. USDA For. Serv., North. Reg., Div. State and Priv. For., Rep. 72-4, 7 p.

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Denton, Robert E., and Leon J. Theroux
1979. An annotated bibliography of the larch casebearer (Coleophora laricella [Hübner]). USDA For. Serv. Gen. Tech. Rep. INT-52, 29 p. Intermt. For. and Range Exp. Stn., Ogden, Utah 84401.

The contents of 147 published references on the larch casebearer are annotated. Citations are cross-referenced by subject as well as by author. An appendix lists 30 unpublished reports.

KEYWORDS: Larch casebearer, annotated bibliography, host tree species, host tree impacts, forest insect ecology, biological control, chemical control, parasites, parasitism, bird predation.

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KEYWORDS: Larch casebearer, annotated bibliography, host tree species, host tree impacts, forest insect ecology, biological control, chemical control, parasites, parasitism, bird predation.

Headquarters for the Intermountain Forest and Range Experiment Station are in Ogden, Utah. Field programs and research work units are maintained in:

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